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Science and Man . . . By Joshua Lederberg

A Tax on Nutrition

AMINO ACID deficiency is the greatest tax on the nutritional well-being of the world's citizens. In many diets, food crops furnish insufficient quantities of lysine, threonine, tryptophan, and perhaps methionine and some other amino acids. Each is a specific molecule with an individual function. Each must be furnished in adequate quantity.

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The people of wealthier countries obtain their quota of essential amino acids from luxury foods like beef, fowl, fish or milk, the so-called animal proteins, which are not available to impoverished populations. Malnutrition is therefore an economic disease.

Amino acid deficiency is also a genetic disease to which the entire human species (as far as we know) is vulnerable. Biosynthetic processes generally are under the control of genes: man's usual capacity to make his own amino acid, tyrosine, can be impaired by a mutation in the gene that codes for the essential enzyme, phenylalanine hydroxylase.

Some evolutionary ancestor of man and other mammals once had the biochemical apparatus to make all of the amino acids, but because there was an abundance of them in the diet the genes irretrievably lost their capacity for internal synthesis. Green plants, yeasts and many microbes still make their own. When we obtain amino acids from our diet we are in effect relying on the genes that have been preserved in more autonomous species.

THE SOLUTIONS proposed for this biochemical shortcoming must be judged on economic grounds. The culture and hunting of animals give the most palatable answers, but on the whole these answers are too costly to meet the world problem. We can, however, stretch the existng supplies many fold, one way is to process fish into a protein-rich flour.

Research toward more systematic, thoughtful answers should be a fundamental part of our foreign policy, but the work that is going on is a pitiable fraction of what is required to meet the urgent needs of humanity. We can, however, point to a scattering of exciting starting points.

Genetic modification of existing crop plants, and the domestication of new ones, are among the most incisive innovations. For example, in corn we have found mutant genes that greatly increase the proportion of lysine in the meal. To extend this observation, we should have a deeper understanding of how this mutation works. It appears to involve suppression of the synthesis of one seed protein, zein. This lets another nutritionally more favorable protein, gliadin, take its place.

Obviously, the more we learn about the control of protein synthesis in plant cells, the better able we will be to produce crops with the most desirable composition. We have hardly begun to use the many imaginative tricks that are possible in this game.

CAREFUL TECHNICAL evaluation of existing resources can be the most productive approach. From this we learn that oilseed meals are an especially useful source of effective proteins. So far they have been little exploited in human nutrition.

Much research is still needed, however, to turn the new flours made from soybeans, cottonseed and peanuts into a widely accepted foodstuff. Little has been done to improve the yield, composition and palatability of oilseed crops, or their adaptability to different climates.

Much of this work should be done in the developing countries where the crops will have to be grown. America should export the means for finding out, rather than blindly transplant North American agricultural science to other habitats.

The production of "single-cell protein" by the fermentation of petroleum wastes has attracted much attention. The process is not yet practical either in cost or in wide acceptability of the nutrient product as food.

It shows, however, that it is possible for an industrial process to replace the universal genetic defect inherent in humans.

More direct chemical methods for synthesis of amino acids are already well known, and there is probably no limit to how cheaply they can be made once the necessary development work is done.